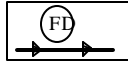


STD & SPEC 3.10 TEMPORARY FILL DIVERSION



Practice Description

A channel with a supporting ridge of soil on the lower side, constructed along the top of an active earth fill, to divert storm runoff away from the unprotected slope of the fill to a stabilized outlet or sediment-trapping facility.

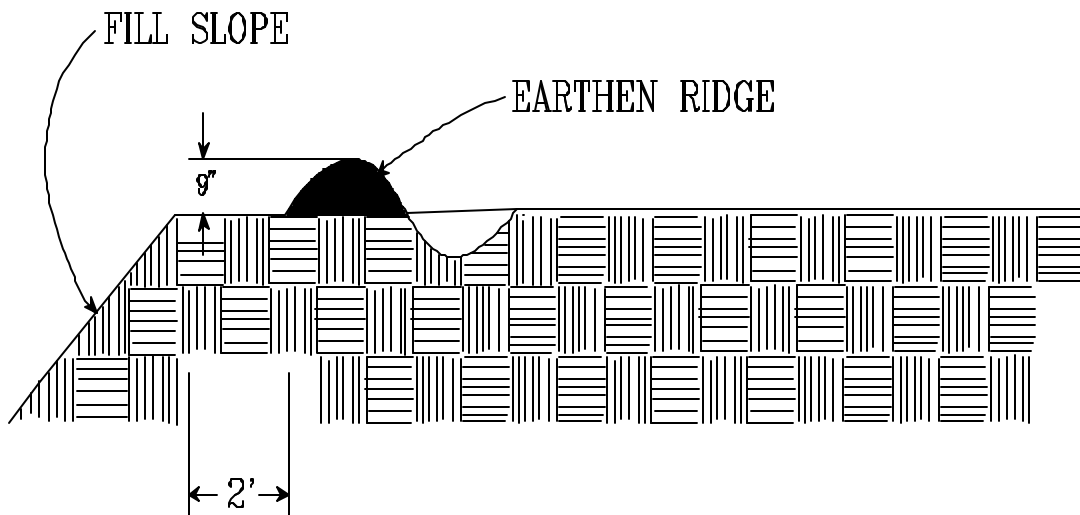
Conditions Where Practice Applies

Where the drainage area at the top of an active earth fill slopes toward the exposed slope and where continuous fill operations make the use of a DIVERSION (Std. & Spec. 3.12) unfeasible. This temporary structure should remain in place for less than one week. The maximum allowable drainage area is 5 acres.

Construction Specifications

1. Height: The minimum height of the supporting ridge shall be 9 inches (see Plate 3.10-1).
2. Grade: The channel shall have a positive grade to a stabilized outlet.
3. Outlet: The diverted runoff should be released through a stabilized outlet, slope drain or sediment trapping measure.
4. The diversion shall be constructed at the top of the fill at the end of each work day as needed.
5. The diversion shall be located at least 2 feet inside the top edge of the fill (see Plate 3.10-1).
6. The supporting ridge shall be constructed with a uniform height along its entire length. Without uniform height, the fill diversion may be susceptible to breaching.

TEMPORARY FILL DIVERSION



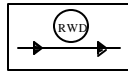
SOURCE: VA. DSWC

PLATE 3.10-1

Maintenance

Since the practice is temporary and under most situations will be covered the next work day, the maintenance required should be low. If the practice is to remain in use for more than one day, an inspection will be made at the end of each work day and repairs made to the measure if needed. The contractor should avoid the placement of any material over the structure while it is in use. Construction traffic should not be permitted to cross the diversion.

STD & SPEC 3.11 TEMPORARY RIGHT-OF-WAY DIVERSION



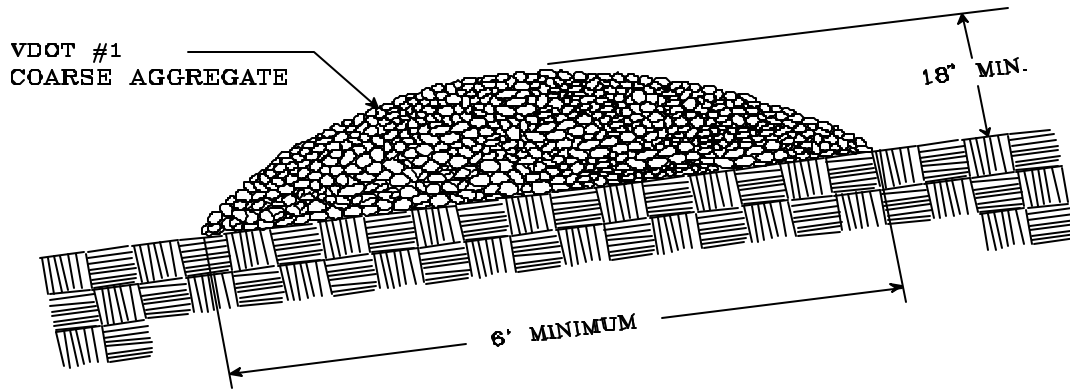
Practice Description

A ridge of compacted soil or loose rock or gravel constructed across disturbed rights-of-way and similar sloping areas, to shorten the flow length within a sloping right-of-way, thereby reducing the erosion potential by diverting storm runoff to a stabilized outlet.

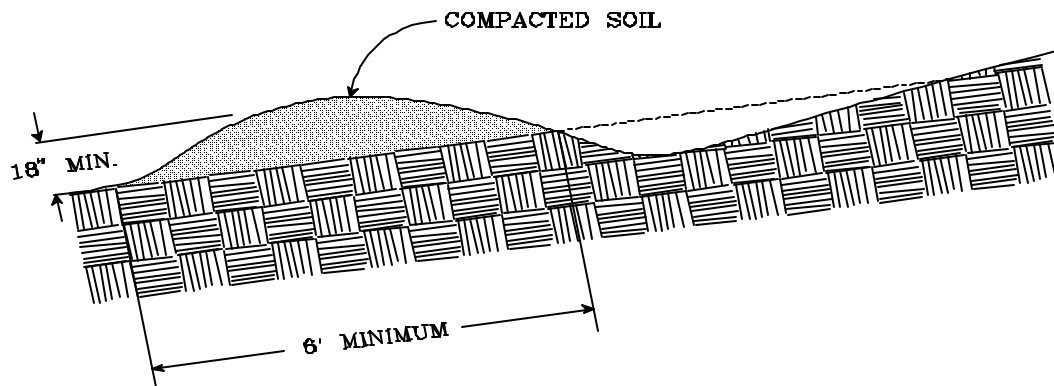
Conditions Where Practice Applies

Generally, earthen diversions are applicable where there will be little or no construction traffic within the right-of-way. Gravel structures are more applicable to roads and other rights-of-way that accommodate vehicular traffic.

TEMPORARY RIGHT-OF-WAY DIVERSIONS



TYPICAL GRAVEL STRUCTURE



TYPICAL EARTHEN STRUCTURE

Source: Va. SWCC

Plate 3.11-1

**TABLE 3.11-A
SPACING OF RIGHT OF WAY
DIVERSIONS**

<u>%Slope</u>	<u>Spacing (ft.)</u>
Less than 7%	100
Between 7% and 25%	75
Between 25% and 40%	50
Greater than 40%	25

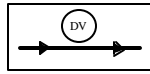
Construction Specifications

1. Height: The minimum allowable height of the diversion shall be 18 inches (see Plate 3.11-1).
2. Side Slopes: Side slopes should be 2:1 or flatter to allow the passage of construction traffic, along with a minimum base width of 6 feet (see Plate 3.11-1).
3. Width: The measure should be constructed completely across the disturbed portion of the right-of-way.
4. Spacing: Table 3.11-A will be used to determine the spacing of right-of-way diversions.
5. Grade: Positive drainage (with less than 2% slope) should be provided to a stabilized outlet, sediment-trapping facility, or a vegetative buffer strip of adequate size.
6. The diversion shall be installed as soon as the right-of-way has been cleared and/or graded.
7. All earthen diversions shall be machine- or hand-compacted in 8-inch lifts.
8. The outlet of the diversion shall be located on an undisturbed and stabilized area when at all possible. The field location should be adjusted as needed to utilize a stabilized outlet.
9. Earthen diversions which will not be subject to construction traffic should be stabilized in accordance with TEMPORARY SEEDING (Std. & Spec. 3.31).

Maintenance

The practice shall be inspected after every rainfall and repairs made if necessary. At least once every two weeks, whether a storm has occurred or not, the measure shall be inspected and repairs made if needed. Right-of-way diversions, which are subject to damage by vehicular traffic, should be reshaped at the end of each working day.

STD & SPEC 3.12 DIVERSION



Practice Description

A channel constructed across a slope with a supporting earthen ridge on the lower side, to reduce slope length and to intercept and divert stormwater runoff to stabilized outlets at non-erosive velocities.

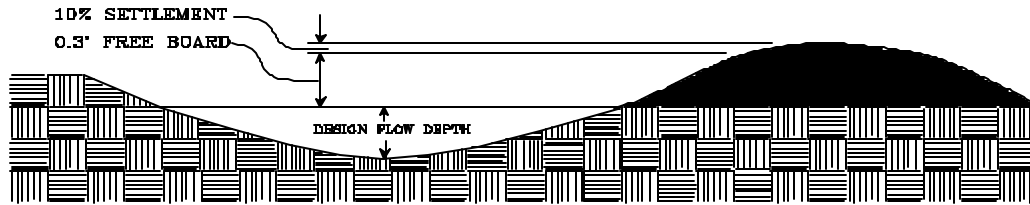
Conditions Where Practice Applies

1. Where runoff from areas of higher elevation may damage property, cause erosion, or interfere with the establishment of vegetation on lower areas.
2. Where surface and/or shallow subsurface flow is damaging sloping upland.
3. Where the slope length needs to be reduced to minimize soil loss.

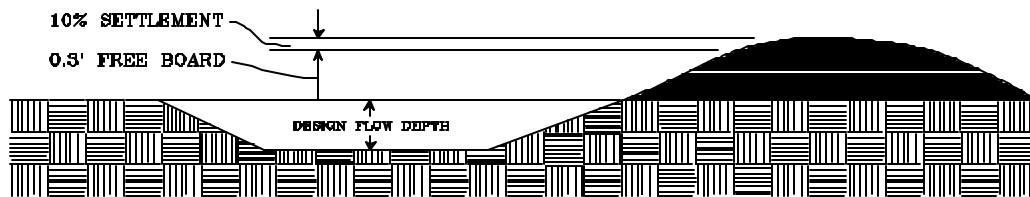
Construction Specifications

1. Ridge: The supporting ridge cross-sectioned shall meet the following criteria:
 - a. The side slopes shall be no steeper than 2:1.
 - b. The width at the design water elevation shall be a minimum of 4 feet.
 - c. The minimum freeboard shall be 0.3 foot.
 - d. The design shall include a 10 percent settlement factor.
2. Outlet: Diversions shall have adequate outlets which will convey concentrated runoff without erosion. Acceptable outlets include STORMWATER CONVEYANCE CHANNEL (Std. & Spec. 3.17); LEVEL SPREADER (Std. & Spec. 3.21); OUTLET PROTECTION (Std. & Spec. 3.18); and PAVED FLUME (Std. & Spec. 3.16).
3. Stabilization:
 - a. The ridge and channel shall be seeded and mulched immediately following their construction in accordance with Std. & Spec. 3.32, PERMANENT SEEDING.

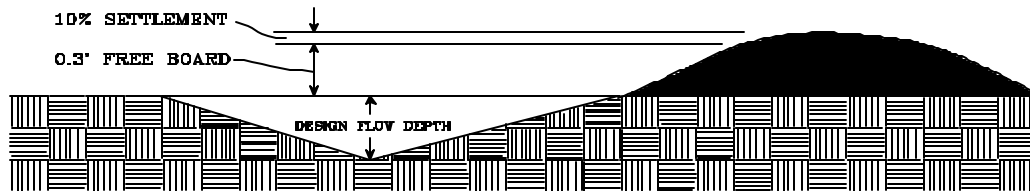
DIVERSIONS



TYPICAL PARABOLIC DIVERSION



TYPICAL TRAPEZOIDAL DIVERSION



TYPICAL VEE-SHAPED DIVERSION

Source: Va. DSWC

Plate 3.12-1

- b. Disturbed areas draining into the diversion should normally be seeded and mulched prior to the time the diversion is constructed. Sediment trapping measures must remain in place to prevent soil movement into the diversion if upslope area is not stabilized.
4. All trees, brush, stumps, obstructions, and other objectionable material shall be removed and disposed of so as not to interfere with the proper functioning of the diversion.
5. The diversion shall be excavated or shaped to line, grade, and cross-section as required to meet the criteria specified herein, free of irregularities that will impede flow.
6. Fills shall be compacted as needed to prevent unequal settlement that would cause damage in the completed diversion. Fill shall be composed of soil that is free from excessive organic debris, rocks or other objectionable materials.
7. All earth removed and not needed in construction shall be spread or disposed of so that it will not interfere with the functioning of the diversion.
8. Permanent stabilization of disturbed areas shall be done in accordance with the applicable standard and specification contained in this handbook. Permanent stabilization techniques include PERMANENT SEEDING (Std. & Spec. 3.32).

Maintenance

Before final stabilization, the diversion should be inspected after every rainfall and at least once every two weeks. Sediment shall be removed from the channel and repairs made as necessary. Seeded areas that fail to establish a vegetative cover shall be reseeded as necessary.

STD & SPEC 3.13 TEMPORARY SEDIMENT TRAP



Practice Description

A temporary ponding area formed by constructing an earthen embankment with a stone outlet, used to detain sediment-laden runoff from small disturbed areas long enough to allow the majority of the sediment to settle out.

Conditions Where Practice Applies

1. Below disturbed areas where the total contributing drainage is less than 3 acres.
2. Where the sediment trap will be used no longer than 18 months (the maximum useful life is 18 months).
3. The sediment trap may be constructed either independently or in conjunction with a TEMPORARY DIVERSION DIKE (Std. & Spec. 3.09).

Construction Specifications

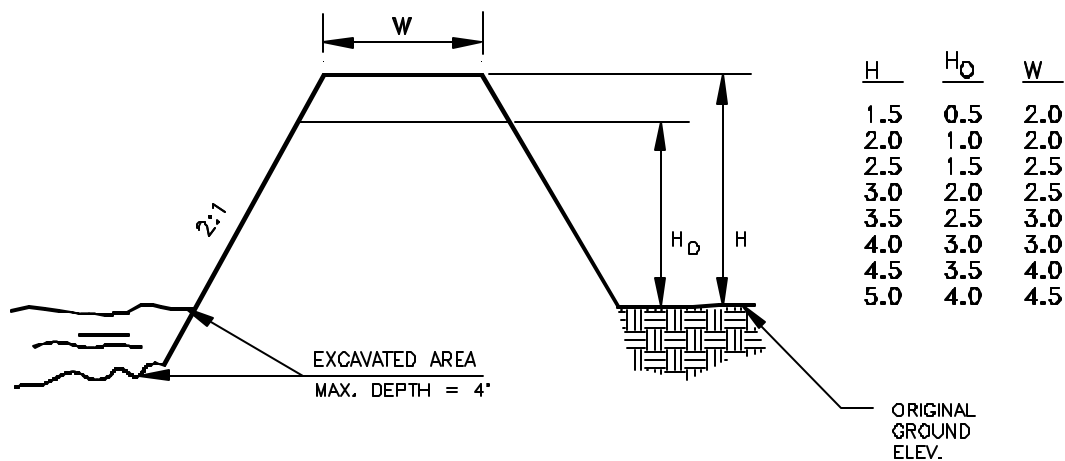
1. Outlet: The outlet for the sediment trap shall consist of a stone section of the embankment located at the low point in the basin. A combination of course aggregate and riprap shall be used to provide for filtering/detention as well as outlet stability. The smaller stone shall be VDOT #3, #357, or #5 Coarse Aggregate (smaller stone sizes will enhance filter efficiency) and riprap shall be "Class I". Filter cloth which meets the physical requirements noted in Std. & Spec. 3.19, RIPRAP shall be placed at the stone-soil interface to act as a "separator."

The minimum length of the outlet shall be 6 feet times the number of acres comprising the total area draining to the trap. The crest of the stone outlet must be at least 1.0 foot below the top of the embankment to ensure that the flow will travel over the stone and not the embankment. The outlet shall be configured as noted in Plate 3.13-2.

2. Embankment Cross Section: The maximum height of the sediment trap embankment shall be 5 feet as measured from the base of the stone outlet. Minimum top widths (W) and outlet heights (Ho) for various embankment heights (H) are shown in Plate 3.13-1. Side slopes of the embankment shall be 2:1 of flatter.
3. The area under the embankment shall be cleared, grubbed, and stripped of any vegetation and root mat.
4. Fill material for the embankment shall be free of roots or other woody vegetation, organic material, large stones, and other objectionable material. The embankment should be compacted in 6-inch layers by traversing with construction equipment.

5. The earthen embankment shall be seeded with temporary or permanent vegetation (see Std. & Spec.'s 3.31 and 3.32) immediately after installation.
6. Construction operations shall be carried out in such a manner that erosion and water pollution are minimized.
7. The structure shall be removed and the area stabilized when the upslope drainage area has been stabilized.
8. All cut and fill slopes shall be 2:1 or flatter (except for excavated, wet storage area which may be at a maximum 1:1 grade).

*MINIMUM TOP WIDTH (W)
REQUIRED FOR SEDIMENT
TRAP EMBANKMENTS
ACCORDING TO HEIGHT OF
EMBANKMENT (FEET)*



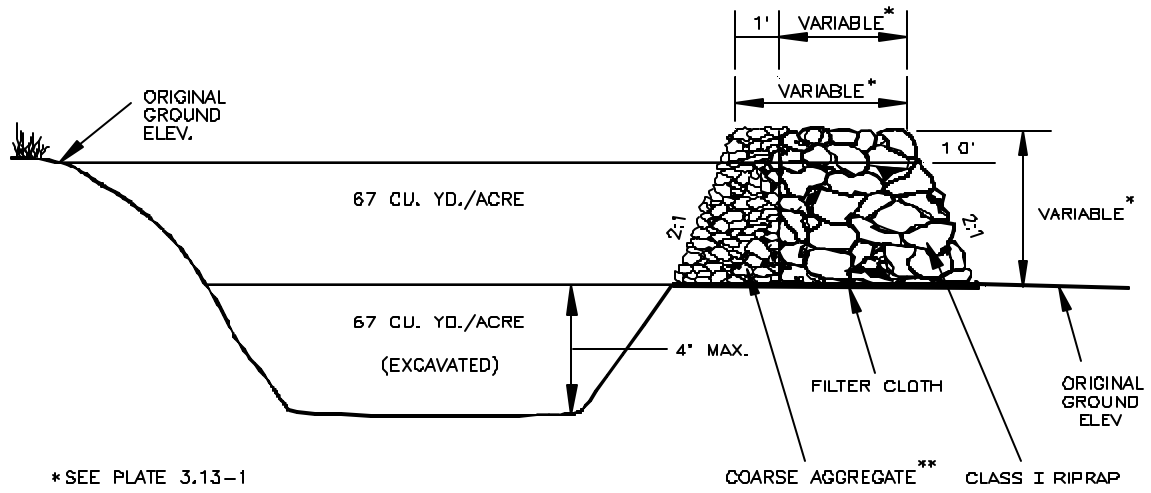
SOURCE: VA. DSWC

PLATE. 3.13-1

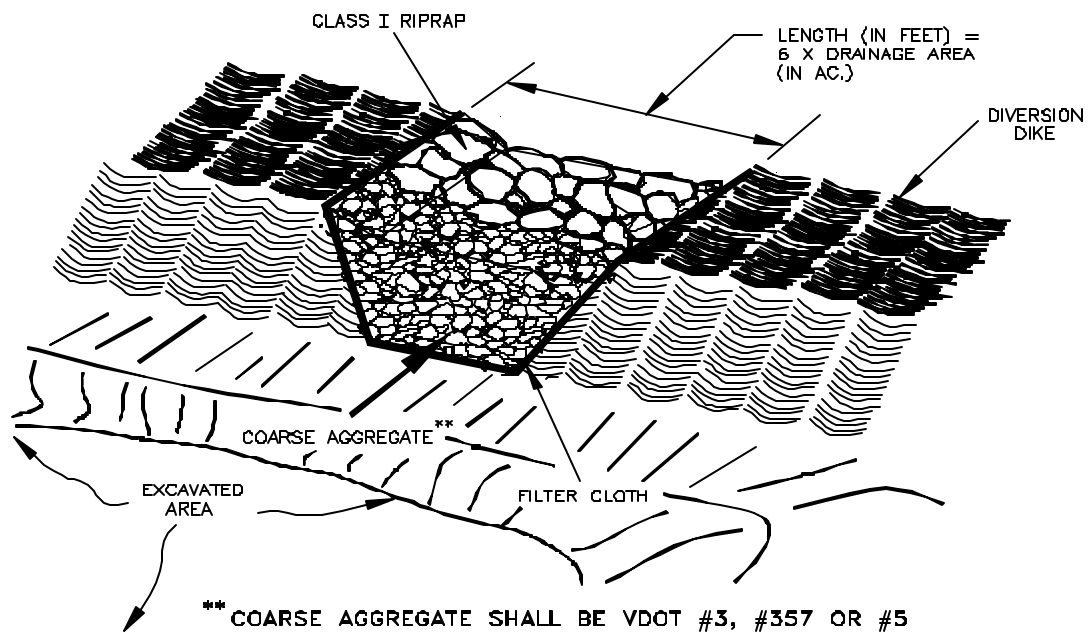
Maintenance

1. Sediment shall be removed and the trap restored to its original dimensions when the sediment has accumulated to one-half the design volume of the wet storage. Sediment removal from the basin shall be deposited in a suitable area and in such a manner that it will not erode and cause sedimentation problems.
2. Filter stone shall be regularly checked to ensure that filtration performance is maintained. Stone choked with sediment shall be removed and cleaned or replaced.
3. The structure should be checked regularly to ensure that it is structurally sound and has not been damaged by erosion or construction equipment. The height of the stone outlet should be checked to ensure that its center is at least 1 foot below the top of the embankment.

TEMPORARY SEDIMENT TRAP



CROSS SECTION OF OUTLET



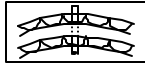
OUTLET (PERSPECTIVE VIEW)

SOURCE: VA. DSWC

PLATE. 3.13-2

STD & SPEC 3.14

TEMPORARY SEDIMENT BASIN



Practice Description

A temporary barrier or dam with a controlled stormwater release structure formed by constructing an embankment of compacted soil across a drainageway, used to detain sediment-laden runoff from disturbed areas in "wet" and "dry" storage long enough for the majority of the sediment to settle out.

Conditions Where Practice Applies

Constructed below disturbed areas where the total drainage area is equal to or greater than three (3) acres. There must be sufficient space and appropriate topography for the construction of a temporary impoundment. These structures are limited to a useful life of 18 months unless they are designed as permanent impoundments. It is recommended that these measures, by virtue of their potential to impound large volumes of water, be designed by a qualified professional.

Construction Specifications

1. **Site Preparation**: Areas under the embankment or any structural works related to the basin shall be cleared, grubbed, and stripped of topsoil to remove trees, vegetation, roots, and other objectionable material. In order to facilitate cleanout and restoration, the area of most frequent inundation (measured from the top of the principal spillway) will be cleared of all brush and trees.
2. **Cutoff Trench**: For earth-fill embankments, a cutoff trench shall be excavated along the centerline of the dam. The trench must extend at least 1 foot into a stable, impervious layer of soil and have a minimum depth of 2 feet. The cutoff trench shall extend up both abutments to the riser crest elevation. The minimum bottom width shall be 4 feet, but also must be wide enough to permit operation of compaction equipment. The side slopes shall be no steeper than 1:1.

Compaction requirements shall be the same as those for the embankment. The trench shall be drained during the backfilling/compacting operations.

3. **Embankment**: For embankments of less than 10 feet, the embankment must have a minimum top width of 6 feet, and the side slopes must be 2:1 or flatter. In the case of an embankment 10 to 14 feet in height, the minimum top width shall be 8 feet and the side slopes shall be 2-1/2:1 or flatter. For 15-foot embankment (maximum allowed under these specifications), the top width must be 10 feet with maximum 2-1/2:1 side slopes.

The fill material shall be taken from approved borrow areas. It shall be clean mineral soil, free of roots, woody vegetation, stumps, sod, oversized stones, rocks, or other perishable or objectionable material. The material selected must have enough strength for the dam to remain stable and be tight enough, when properly compacted, to prevent excessive percolation of water through the dam. Fill containing particles ranging from small gravel or coarse sand to fine sand and clay in desired proportion is appropriate. Any embankment material should contain approximately 20% clay particles by weight.

Using the Unified Soil Classification System, SC (clayey sand), GC (clayey gravel) and CL ("low liquid limit" clay) are among the preferred types of embankment soils.

Areas on which fill is to be placed shall be scarified prior to placement of fill. The fill material should contain the proper amount of moisture to ensure that 95% compaction will be achieved. Fill material will be placed in 6-inch continuous layers over the entire length of fill. Compaction shall be obtained by routing the hauling equipment over the fill so that the entire surface of the fill is transversed by at least one wheel or tread track of equipment, or by using a compactor. Special care shall be taken in compacting around the anti-seep collars (compact by hand, if necessary) to avoid damage and achieve the desired compaction. The embankment shall be constructed to an elevation 10% higher than the design height to allow for settlement if compaction is obtained with hauling equipment. If compactors are used for compaction, the overbuild may be reduced to not less than 5%.

4. Principal Spillway: To increase the efficiency of the basin, the spillway(s) must be designed to maintain a permanent pool of water between storm events. The principal spillway should consist of a solid (non-perforated) vertical box or pipe of reinforced concrete or corrugated metal, with a minimum diameter of 15 inches. The riser of the spillway shall be securely attached to the barrel by a watertight connection. The barrel and riser shall be placed on a firmly compacted soil foundation. The base of the riser shall be firmly anchored according to design criteria to prevent its floating. Pervious materials such as sand, gravel, or crushed stone shall not be used as backfill around the barrel or anti-seep collars. Special care shall be taken in compacting around the anti-seep collars (by hand, if necessary). Fill material shall be placed around the pipe in 4-inch layers and compacted until 95% compaction is achieved. A minimum of two feet of fill shall be hand-compacted over the barrel before crossing it with construction equipment.
5. Base: The base of the principal spillway must be firmly anchored to prevent its floating. If the riser of the spillway is greater than 10 feet in height, computations must be made to determine the anchoring requirements. A minimum factor of safety of 1.25 shall be used (downward forces = 1.25 x upward forces).

For risers 10 feet or less in height, the anchoring may be done in one of the two following ways:

- a. A concrete base 18 inches thick and twice the width of riser diameter shall be used and the riser embedded 6 inches into the concrete. (see Plate 3.14-14).
- b. A square steel plate a minimum of 1/4-inch thick and having a width equal to twice the diameter of the riser shall be used; it shall be covered with 2.5 feet of stone, gravel or compacted soil to prevent flotation (see Plate 3.14-14).

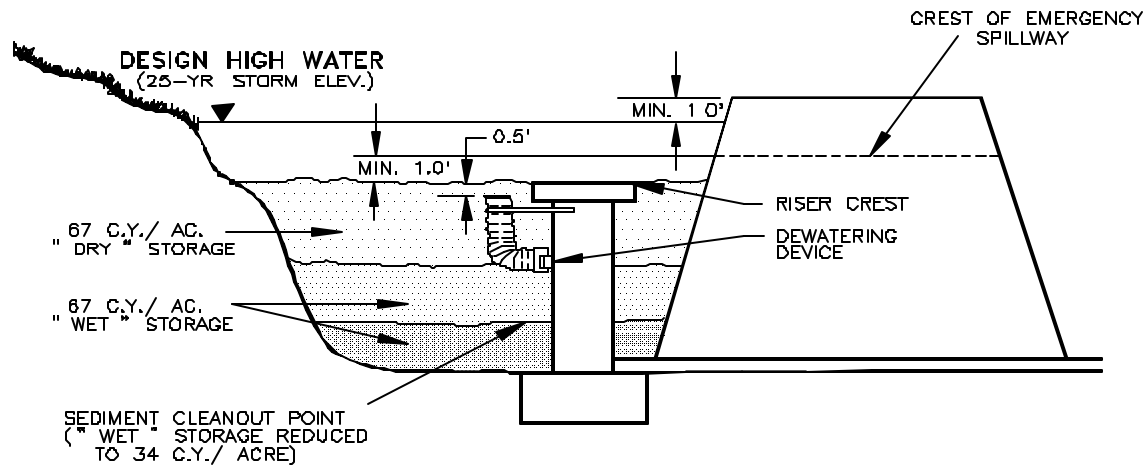
Note: If the steel base is used, special attention should be given to compaction so that 95% compaction is achieved over the plate. Also, added precautions should be taken to ensure that material over the plate is not removed accidentally during removal of sediment from basin.

6. Anti-Vortex Device and Trash Rack: An anti-vortex device and trash rack shall be attached to the top of the principal spillway to improve the flow characteristics of water into spillway and prevent floating debris from blocking the principal spillway.
7. Dewatering: Dewatering of the dry storage should be done in a manner which removes the "cleaner" water without removing the potentially sediment-laden water found in the wet storage area or any appreciable quantities of floating debris.

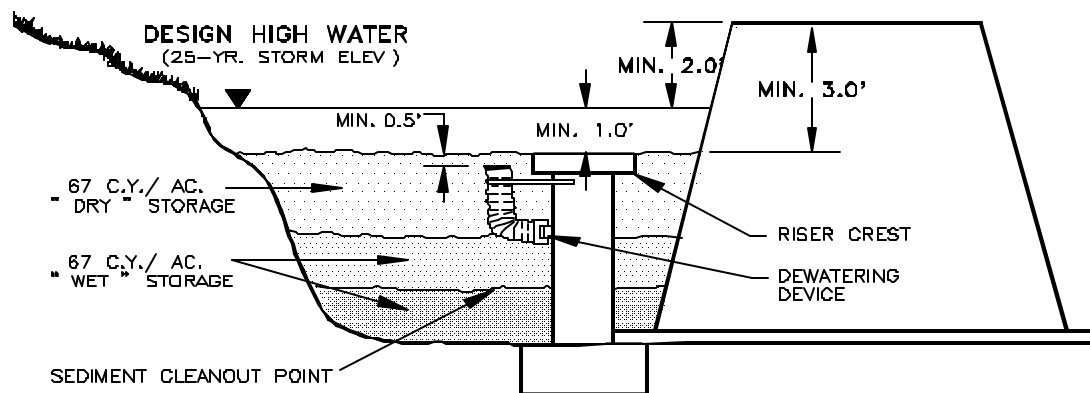
An economical and efficient device for performing the drawdown is a section of perforated vertical tubing that is connected to the principal spillway at two locations. See Plate 3.14-15 that depicts the orientation of such a device. By virtue of the potential for the dewatering device or orifice becoming clogged, no credit is given for drawdown by the device in the calculation of the principal or emergency spillway locations.

8. Anti-Seep Collars: Anti-seep collars shall be used on the barrel of the principal spillway within the normal saturation zone of the embankment to increase the seepage length by at least 10%, if either of the following two conditions is met:
 - a. The settled height of the embankment exceeds 10 feet.
 - b. The embankment has a low silt-clay content (Unified Soil Classes SM or GM) and the barrel is greater than 10 inches in diameter.

SEDIMENT BASIN SCHEMATIC ELEVATIONS



DESIGN ELEVATIONS WITH EMERGENCY SPILLWAY

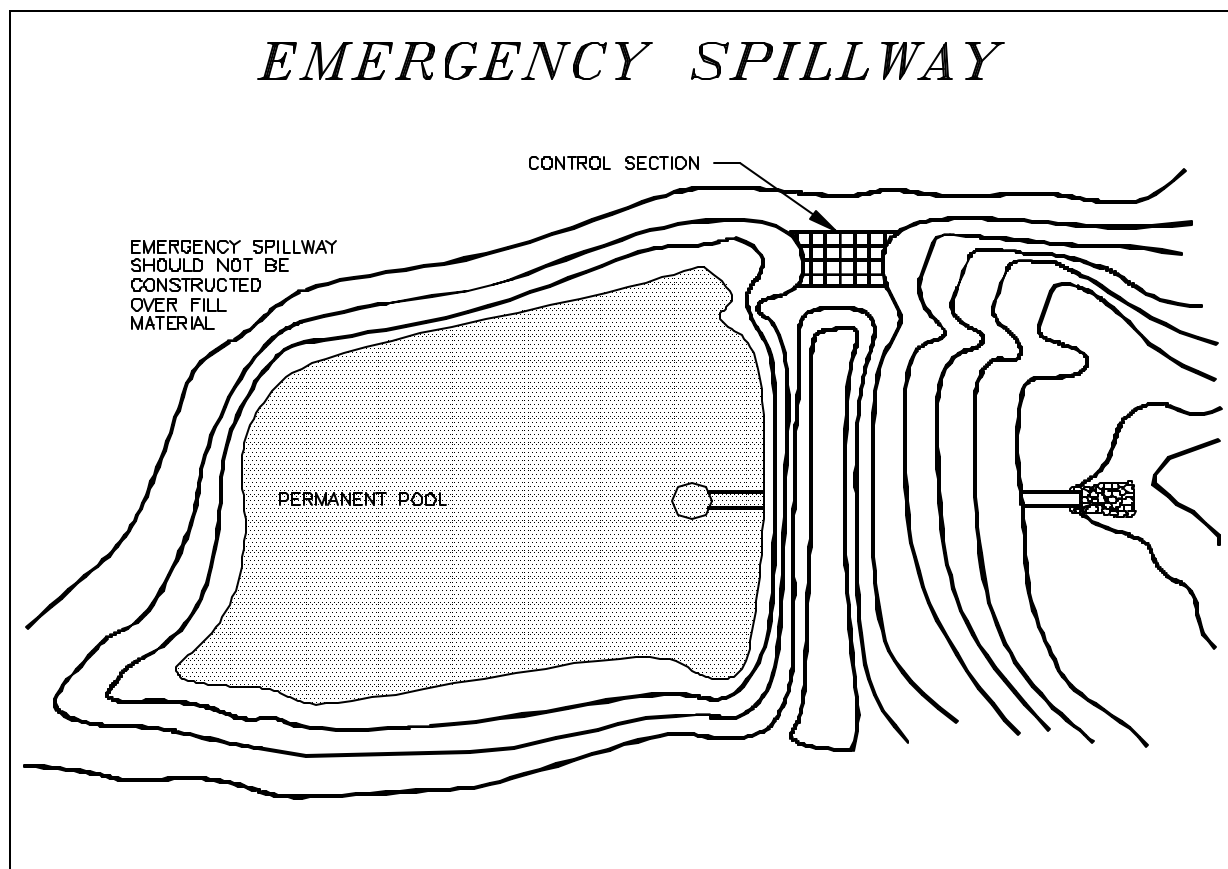


DESIGN ELEVATIONS WITHOUT EMERGENCY SPILLWAY (RISER PASSES 25-YR. EVENT)

SOURCE: VA. DSWC

PLATE. 3.14-2

9. Emergency Spillway: Vegetative emergency spillways shall not be constructed over fill material. Design elevations, widths, entrance and exit slopes are critical to the successful operation of the spillway and should be adhered to closely during construction.
10. Vegetative Stabilization: The embankment and emergency spillway of the sediment basin shall be stabilized with temporary or permanent vegetation immediately after installation of the basin (see TEMPORARY SEEDING, Std. & Spec. 3.31 or PERMANENT SEEDING, Std. & Spec. 3.32).
11. Basin Shape: The shape of the basin must be such that the length to width ratio is at least 2 to 1. The correct basin shape can be obtained by proper site selection, excavation, or the use of baffles. Baffles increase the flow length by deflecting the flow. The baffles should be placed halfway between the inflow point and the outflow. Plate 3.14-6 shows the detail for baffle construction and three situations where baffles might be used.



SOURCE: VA. DSWC

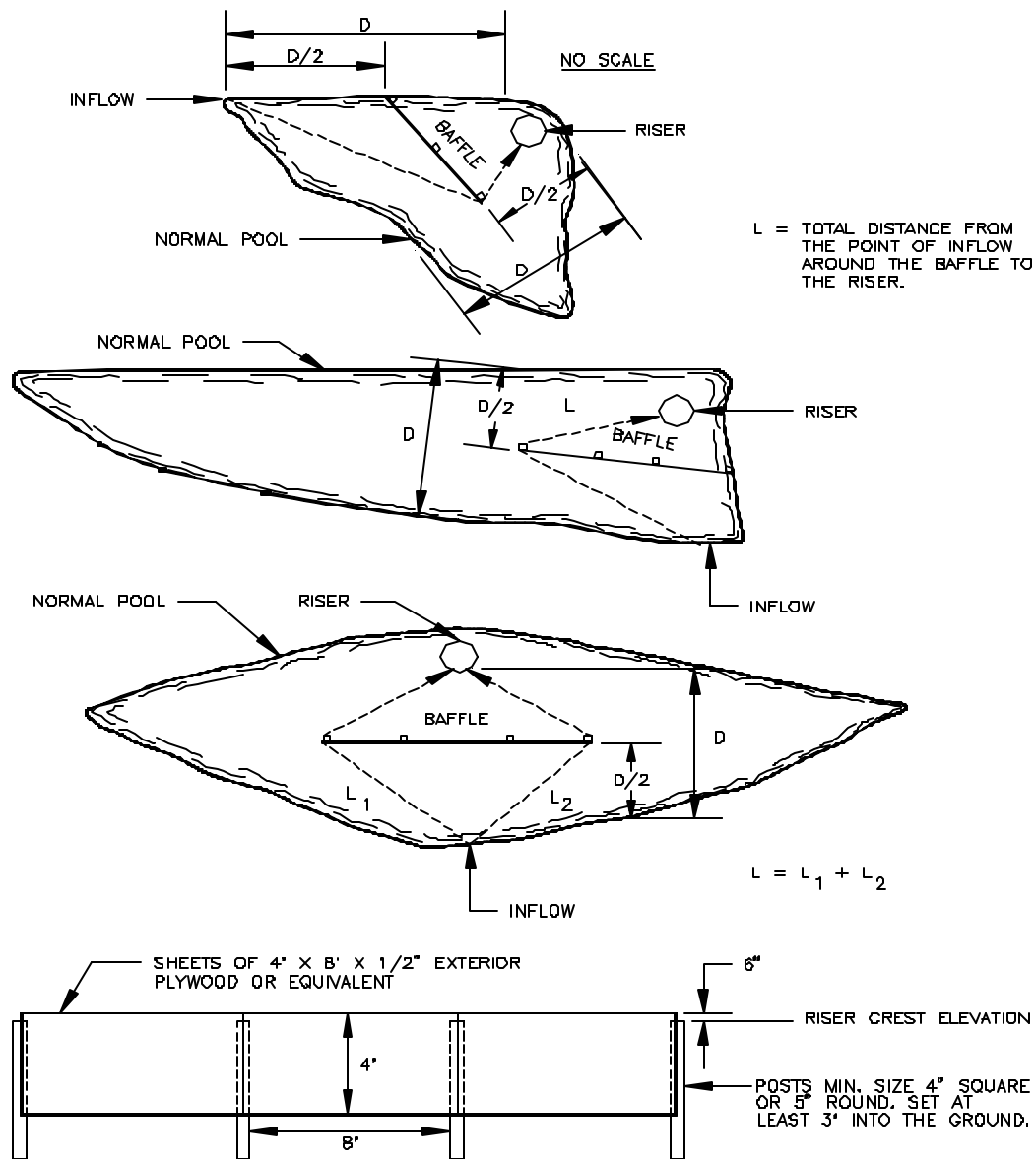
PLATE. 3.14-5

12. Safety: All state and local requirements shall be met concerning fencing and signs warning the public of the hazards of soft, saturated sediment and flood waters should be installed.
13. Erosion and Sediment Control: The construction of the sediment basin shall be carried out in a manner such that it does not result in sediment problems downstream.

Maintenance

The basin embankment should be checked regularly to ensure that it is structurally sound and has not been damaged by erosion or construction equipment. The emergency spillway should be checked regularly to ensure that its lining is well established and erosion resistant. The basin should be checked after each runoff-producing rainfall for sediment build-up. When sediment reaches the cleanout level, it shall be removed and disposed of properly.

EXAMPLE PLAN VIEWS OF BAFFLE LOCATIONS IN SEDIMENT BASINS



SOURCE: USDA-SCS

PLATE. 3.14-6

STD & SPEC 3.15 TEMPORARY SLOPE DRAIN



Practice Description

A flexible tubing or conduit extending from the top to the bottom of a cut or fill slope, to temporarily conduct concentrated stormwater runoff safely down the face of a cut or fill slope without causing erosion on or below the slope.

Conditions Where Practice Applies

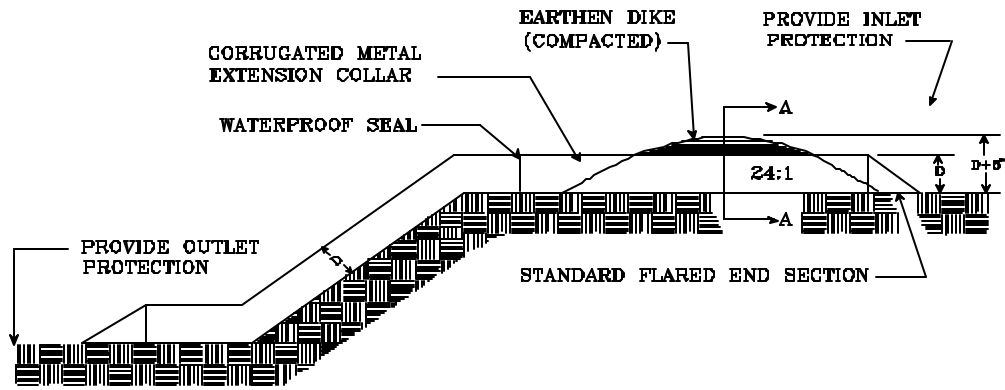
On cut or fill slopes where there is a potential for upslope flows to move over the face of the slope causing erosion and preventing adequate stabilization.

Construction Specifications

1. The measure shall be placed on undisturbed soil or well-compacted fill.
2. The entrance section shall slope toward the slope drain at the minimum rate of 1/2-inch per foot.
3. The soil around and under the entrance section shall be hand-tamped in 8-inch lifts to the top of the dike to prevent piping failure around the inlet.
4. The slope drain shall be securely staked to the slope at the grommets provided.
5. The slope drain sections shall be securely fastened together and have watertight fittings.
6. Install CULVERT INLET PROTECTION and OUTLET PROTECTION as per Std. & Spec.'s 3.08 and 3.18, respectively.

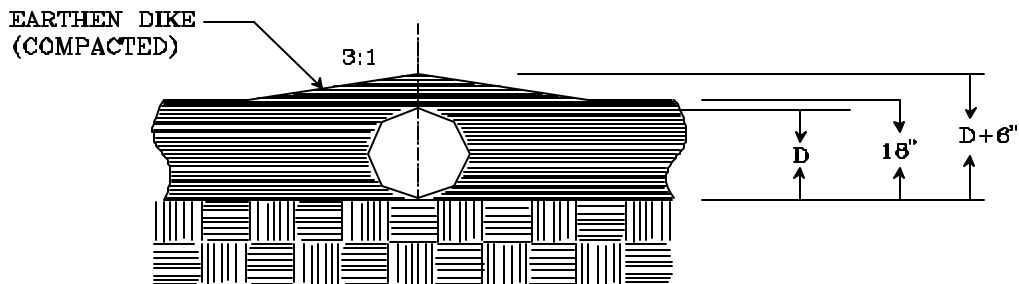
Maintenance

The slope drain structure shall be inspected weekly and after every storm, and repairs made if necessary. The contractor should avoid the placement of any material on and prevent construction traffic across the slope drain.



SECTION VIEW

NOTE: SEDIMENT MAY BE CONTROLLED AT OUTLET IF UPLAND PONDING
WILL CREATE PROBLEMS



SECTION A - A

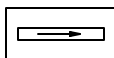
SOURCE: VA. DSWC

PLATE 3.15-1

Table 3.15-A
SIZE OF SLOPE DRAIN

Maximum Drainage Area (acres)	Pipe Diameter (inches)
0.5	12
1.5	18
2.5	21
3.5	24
5.0	30

STD & SPEC 3.17 STORMWATER CONVEYANCE CHANNEL



Practice Description

A permanent, designed waterway, shaped, sized, and lined with appropriate vegetation or structural material, used to safely convey stormwater runoff within or away from a developing area and to provide for the conveyance of concentrated surface runoff water to a receiving channel or system without damage from erosion.

Conditions Where Practice Applies

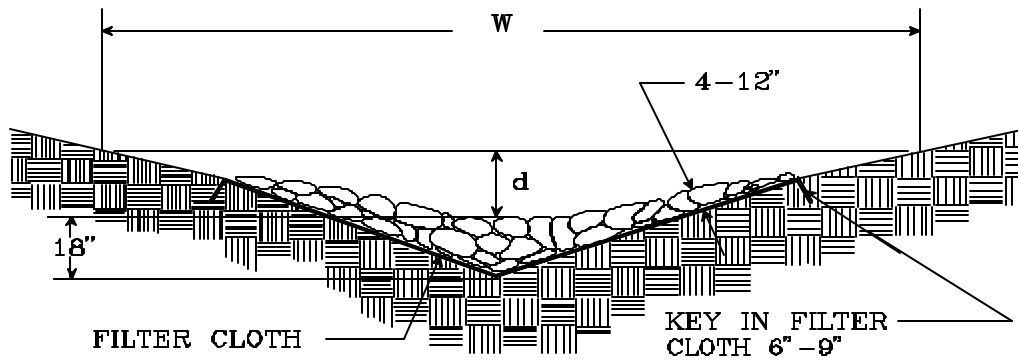
Generally applicable to man-made channels, including roadside ditches and intermittent natural channels, which are constructed or are modified to accommodate flows generated by land development.

Construction Specifications

General:

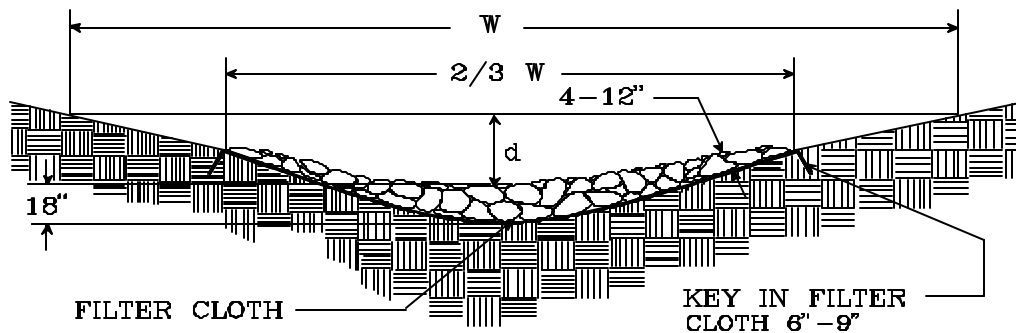
1. All trees, brush, stumps, roots, obstructions and other unsuitable material shall be removed and disposed of properly.
2. The channel shall be excavated or shaped to the proper grade and cross-section.
3. Any fills shall be well compacted to prevent unequal settlement.
4. Any excess soil shall be removed and disposed of properly.
5. The top width of parabolic and vee-shaped, grass-lined channels shall not exceed 30 feet, and the bottom width of trapezoidal, grass lined channels shall not exceed 15 feet unless multiple or divided waterways, riprap center, or other means are provided to control meandering of low flows.
6. Where there will be a base flow in grass-lined channels, a stone center, a subsurface drain, or other suitable means to handle the base flow shall be provided. Plate 3.17-2 shows typical cross-sections for stone center channels.
7. The outlets of all channels shall be protected from erosion (see OUTLET PROTECTION, Std & Spec. 3.18).

STONE-LINED WATERWAYS



V-SHAPED WATERWAY WITH STONE CENTER DRAIN

NOTE: A GRANULAR FILTER MAY BE SUBSTITUTED FOR FILTER CLOTH



PARABOLIC WATERWAY WITH STONE CENTER DRAIN

NOTE: A GRANULAR FILTER MAY BE SUBSTITUTED FOR FILTER CLOTH.

Source: USDA-SCS

Plate 3.17-2

Grass-lined Channels: The method used to establish grass in the ditch or channel will depend upon the severity of the conditions encountered. The methods available for grass establishment are set forth in PERMANENT SEEDING, Std. & Spec. 3.32, and SODDING, Std. & Spec. 3.33. Below is a table which can be used to help choose a successful grass establishment technique, if any of the four conditions is exceeded, the next establishment technique below must be used.

<p align="center">Table 3.17 - A</p> <p align="center"><u>GRASS ESTABLISHMENT</u></p> <p align="center"><u>ALTERNATIVES</u></p>		
<u>Establishment Technique</u>		<u>Conditions</u>
1. (a) Seeding with straw mulch and tack coat. (b) Establishing Bermudagrass by sprigging.		1. Slopes less than 5%. 2. Velocity 3 feet per second or less. 3. Majority of drainage can be diverted away from channel during germination and establishment. 4. Erosion-resistant soils.
2. Seeding with straw mulch and jute mesh or other soil stabilization blankets. (i.e., Treatment-1)		1. Slopes less than 5%. 2. Velocity 4 feet per second or less. 3. Majority of drainage can not be diverted away from channel during germination and establishment. 4. Moderately erodible soil
3. Sodding or use of soil stabilization matting (i.e., Treatment - 2).		1. Slopes greater than 5%. 2. Velocity between 5 feet per second and 6 feet per second. 3. Majority of drainage can not be diverted away from channel during germination and establishment. 4. Highly erodible soil

1. (a) Seeding with straw mulch and tack coat. All seeding shall be done in accordance with PERMANENT SEEDING, Std & Spec. 3.32. When mulching, use 2 tons/acre small grain straw with an acceptable tacking agent. Also refer to MULCHING, Std. & Spec. 3.35.

(b) Bermudagrass establishment by sprigging. Establish Bermudagrass in accordance with BERMUDAGRASS ESTABLISHMENT, Std. & Spec. 3.34 (E&S Handbook). Irrigation water must be available during the first 4 weeks. Divert drainage away from channel during the first three weeks of the establishment period by using temporary dikes, silt fencing, or straw bale barriers.
2. Seeding with straw mulch and jute mesh or other soil stabilization blankets. In addition to (1a) above, straw mulch may be secured with netting to form a soil stabilization blanket. If using a light plastic or paper erosion netting, 1-1/2 to 2 tons/acre of straw is appropriate. Care should be taken to staple the mesh or blankets according to specifications in, Std. & Spec. 3.36, SOIL STABILIZATION BLANKETS & MATTING, Combination blankets, used alone, are also acceptable mulches for waterways.
3. Sodding or use of Soil Stabilization Matting. Sod shall be installed as per Std & Spec, 3.33. Soil stabilization matting shall be installed as per Std. & Spec 3.36, SOIL STABILIZATION BLANKETS & MATTING.

Riprap-lined Channels

Riprap shall be installed in accordance with RIPRAP, Std. & Spec. 3.19.

Concrete-lined Channels

Concrete-lined channels must be constructed in accordance with all applicable VDOT specifications.

Maintenance

Grass-lined Channels: During the initial establishment, grass-lined channels should be repaired immediately and grass re-established if necessary. After grass has become established, the channel should be checked periodically to determine if the grass is withstanding flow velocities without damage. If the channel is to be mowed, it should be done in a manner that will not damage the grass.

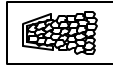
Riprap-lined Channels: Riprap-lined channels should be checked periodically to ensure that scour is not occurring beneath fabric underlining of the riprap layer. The channel should also be checked to determine that the stones are not dislodged by large flows.

Concrete-lined Channels: Concrete-lined channels should be checked periodically to ensure that there is no undermining of the channel. Particular attention should be paid to the outlet of the channel. If scour is occurring at the outlet, appropriate outlet protection shall be installed. See OUTLET PROTECTION, Std. & Spec. 3.18.

Sediment Deposition: If the channel is below a high sediment-producing area, sediment should be trapped before it enters the channel

Many newly constructed conveyance channels become damaged and require costly repairs as a result of improper upslope controls. If sediment is deposited in a grass-lined channel, it should be removed promptly to prevent damage to the grass. Sediment deposited in riprap and concrete-lined channels should be removed when it reduces the capacity of the channel.

STD & SPEC 3.18 OUTLET PROTECTION



Practice Description

Structurally lined aprons or other acceptable energy dissipating devices placed at the outlets of pipes or paved channel sections, used to prevent scour at stormwater outlets, to protect the outlet structure, and to minimize the potential for downstream erosion by reducing the velocity and energy of concentrated stormwater flows.

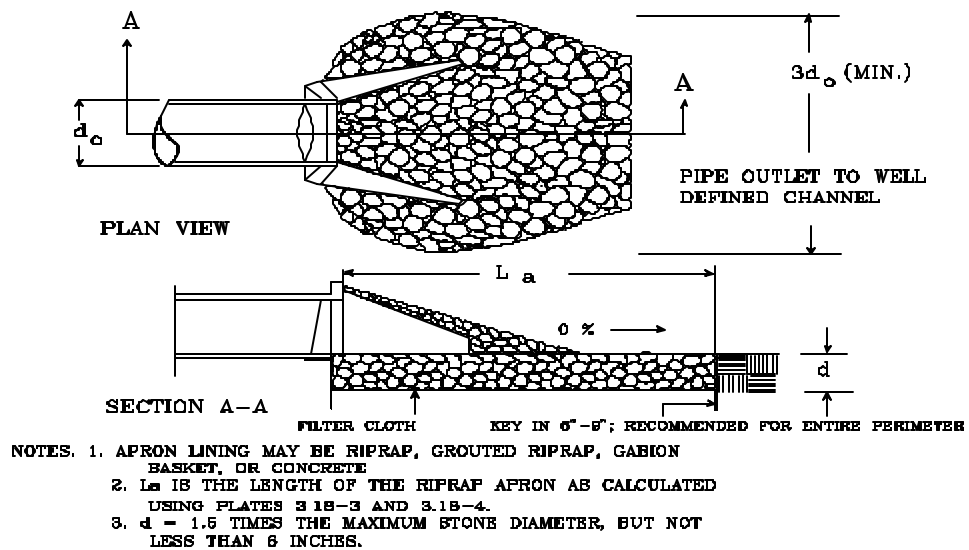
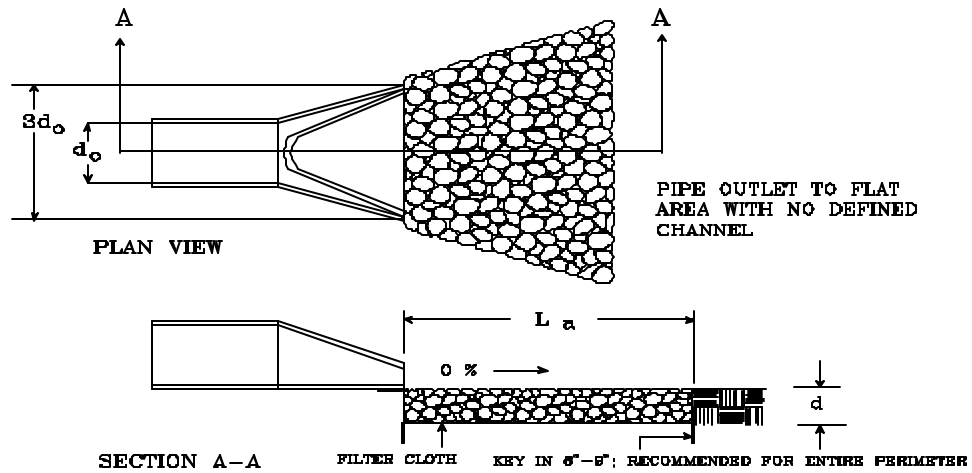
Conditions Where Practice Applies

This practice is applicable to the outlets of all pipes and engineered channel sections.

Construction Specifications

1. Apron dimensions: shall be specified in the plan.
2. Bottom grade: The apron shall be constructed with no slope along its length (0.0% grade). The invert elevation of the downstream end of the apron shall be equal to the elevation of the invert of the receiving channel. There shall be no overfall at the end of the apron.
3. Side slopes: If the pipe discharges into a well-defined channel, the side slopes of the channel shall not be steeper than 2:1 (horizontal: vertical).
4. Alignment: The apron shall be located so there are not bends in the horizontal alignment.
5. Materials: The apron may be lined with riprap, grouted riprap, concrete, or gabion baskets. The median sized stone for riprap shall be specified in the plan. The graduation, quality and placement of riprap shall conform to Std. & Spec. 3.19, RIPRAP.
6. Filter cloth: In all cases, filter cloth shall be placed between the riprap and the underlying soil to prevent soil movement into and through the riprap. The material must meet or exceed the physical properties for filter cloth found in Std. & Spec. 3.19, RIPRAP. See Plate 3.18-1 for orientation details.
7. Concrete Aprons: shall be installed according to specifications and details on the plan.
8. Paved Channel Outlets: The end of the paved channel shall merge smoothly with receiving channel section. There shall be no overfall at the end of the paved section. Where the bottom width of the paved channel is narrower than the bottom width of the receiving channel, a transition section shall be provided.

PIPE OUTLET CONDITIONS

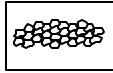


- NOTES.** 1. APRON LINING MAY BE RIPRAP, GROUTED RIPRAP, GABION BASKET, OR CONCRETE
 2. L_a IS THE LENGTH OF THE RIPRAP APRON AS CALCULATED USING PLATES 3.1B-3 AND 3.1B-4.
 3. $d = 1.5$ TIMES THE MAXIMUM STONE DIAMETER, BUT NOT LESS THAN 6 INCHES.

Source: Va. DSWC

Plate 3.1B-1

STD & SPEC 3.19 RIPRAP



Practice Description

A permanent, erosion-resistant ground cover of large, loose, angular stone with filter fabric or granular underlining, used to protect the soil from the erosive forces of concentrated runoff, slow the velocity of concentrated runoff while enhancing the potential for infiltration; also utilized to stabilize slopes with seepage problems and/or non-cohesive soils.

Conditions Where Practice Applies

Wherever soil and water interface and the soil conditions, water turbulence and velocity, expected vegetative cover, etc., are such that the soil may erode under the design flow conditions. Riprap may be used, as appropriate, at stormdrain outlets, on channel banks and/or bottoms, roadside ditches, drop structures and at the toe of slopes, as transition from concrete channels to vegetated channels.

Construction Specifications

1. Quality of Stone: Stone for riprap shall consist of field stone or rough unhewn quarry stone of approximately rectangular shape. The stone shall be hard and angular and of such quality that it will not disintegrate on exposure to water or weathering and it shall be suitable in all respects for the purpose intended.

Rubble concrete may be used provided it meets the requirements of this standard and specification.

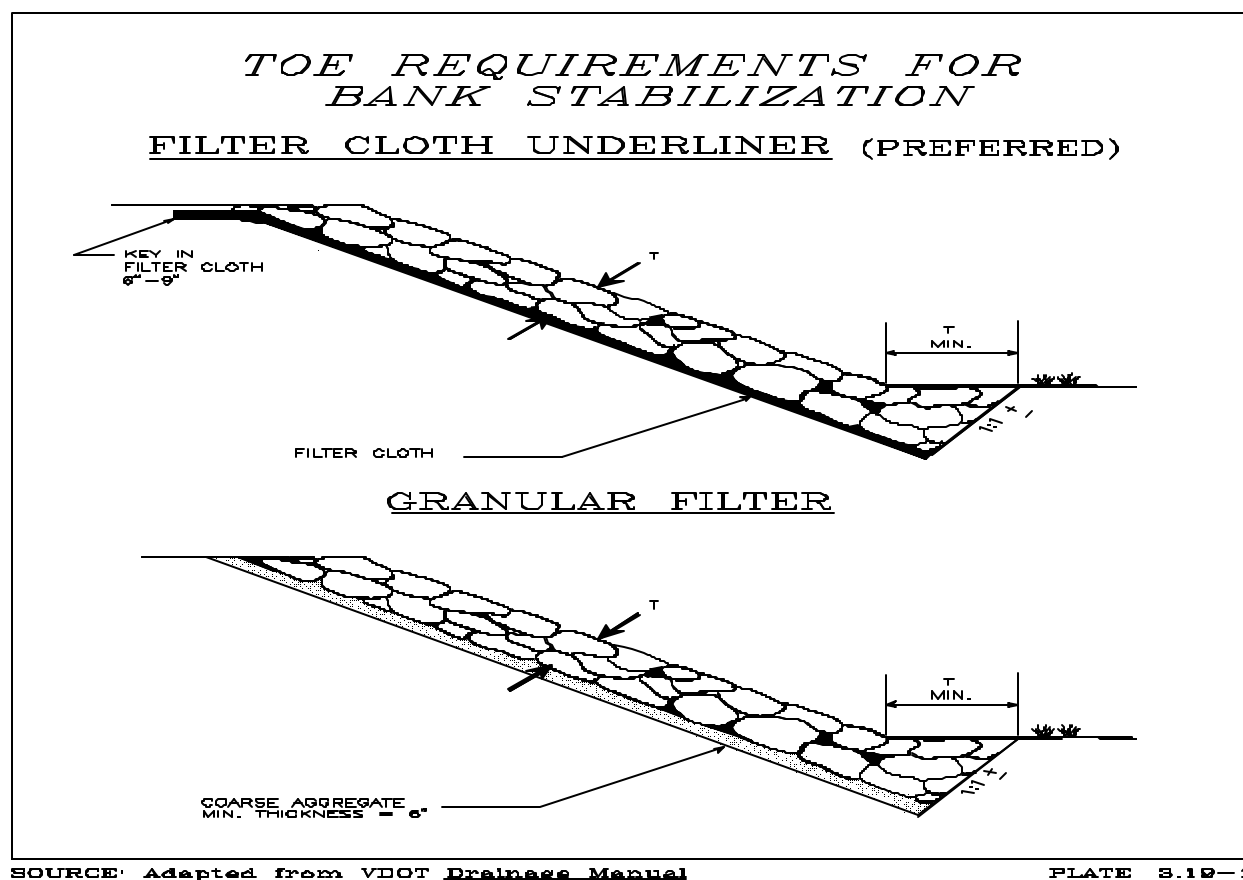
Size and weight of stone utilized must correspond to plan specifications. The following weight analysis of graded riprap may be used to help verify the class or type of stone which is to be placed:

TABLE 3.19 - A
GRADED RIPRAP - WEIGHT ANALYSIS

<u>Riprap Class/Type</u>	<u>Weight Range*(lbs.)</u>	<u>Requirements for Stone Mixture</u>
Class AI	25-75	Max.10% >75 lbs.
Class I	50-150	60% > 100 lbs.
Class II	150-500	50% > 300 lbs.
Class III	500-1,500	50% > 900 lbs.
Type I	1,500-4,000	Av. wt.=2,000lbs.
Type II	6,000-20,000	Av. wt.=8,000lbs.

Source: Adapted from VDOT Road and Bridge Specifications

2. Subgrade Preparation: The subgrade for the riprap or filter shall be prepared to the required lines and grades. Any fill required in the subgrade shall be compacted to a density approximately that of the surrounding undisturbed material. Brush, trees, stumps and other objectionable material shall be removed.
3. Filter Fabric or Granular Filter: Placement of the filter fabric should be done immediately after slope preparation. For granular filters, the stone should be spread in a uniform layer to the specified depth (normally 6 inches). Where more than one layer of filter material is used, the layer should be spread so that there is minimal mixing of the layers. When installing geotextile filter cloths, the cloth should be placed directly on the prepared slope. The edges of the sheets should overlap by at least 12 inches. Anchor pins, 15 inches long, should be spaced every 3 feet along the overlap. The upper and lower ends of the cloth should be buried at least 12 inches. Care should be taken not to damage the cloth when placing the riprap. If damage occurs, that sheet should be removed and replaced. For large stone (Class II or greater), a 6-inch layer of granular filter will be necessary to prevent damage to the cloth.



Stone Placement: Placement of riprap should follow immediately after placement of the filter. The riprap should be placed so that it produces a dense well-graded mass of stone with a minimum of voids. The desired distribution of stones throughout the mass may be obtained by selective loading at the quarry, controlled dumping of successive loads during final placing, or by a combination of these methods.

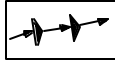
The riprap should be placed to its full thickness in one operation. The riprap should not be placed in layers. The riprap should not be placed by dumping into chutes or similar methods that are likely to cause segregation of the various stone sizes. Care should be taken not to dislodge the underlying material when placing the stones.

The finished slope should be free of pockets of small stone or clusters of large stones. Hand placing may be necessary to achieve the required grades and a good distribution of stone sizes. Final thickness of the riprap blanket should be within plus or minus 1/4 of the specified thickness.

Maintenance

Once a riprap installation has been completed, it should require very little maintenance. It should, however, be inspected periodically to determine if high flows have caused scour beneath the riprap or filter fabric or dislodged any of the stone. Care must be taken to properly control sediment-laden construction runoff which may drain to the point of the new installation. If repairs are needed, they should be accomplished immediately.

STD & SPEC 3.20 ROCK CHECK DAMS



Practice Description

Small temporary stone dams constructed across a swale or drainage ditch, to reduce the velocity of concentrated stormwater flows, thereby reducing erosion of the swale or ditch. This practice also traps sediment generated from adjacent areas or the ditch itself, mainly by ponding of the stormwater runoff. Field experience has shown it to perform more effectively than silt fence or straw bales in the effort to stabilize "wet-weather" ditches.

Conditions Where Practice Applies

This practice, utilizing a combination of stone sizes, is limited to use in small open channels that drain 10 acres or less. It should not be used in a live stream as the objective should be to protect the live watercourse. Some specific applications include:

1. Temporary ditches or swales that because of their short length of service, cannot receive a non-erodible lining but still need protection to reduce erosion.
2. Permanent ditches or swales, which for some reason, cannot receive a permanent non-erodible lining for an extended period of time.
3. Either temporary or permanent ditches or swales which need protection during the establishment of grass linings.
4. An aid in the sediment trapping strategy for a construction site.

This practice is not a substitute for major perimeter trapping measures such as a SEDIMENT TRAP (Std. & Spec. 3.13) or a SEDIMENT BASIN (Std. & Spec. 3.14).

Construction Specifications

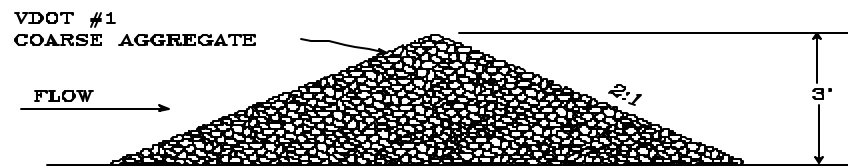
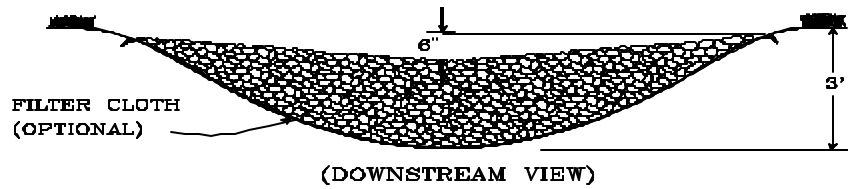
1. The drainage area of the ditch or swale being protected shall not exceed 2 acres when VDOT #1 Coarse Aggregate is used alone and shall not exceed 10 acres when a combination of Class I Riprap (added for stability) and VDOT #1 Coarse Aggregate is used. Refer to Plate 3.20-1 for orientation of stone and a cross-sectional view of the measure. An effort should be made to extend the stone to the top of channel banks.
2. However, the maximum height of the dam shall be 3.0 feet.
3. The center of the check dam must be at least 6 inches lower than the outer edges. Field experience has shown that many dams are not constructed to promote this "weir" effect. Stormwater flows are then forced to the stone-soil interface, thereby promoting scour at that point and subsequent failure of the structure to perform its intended function.
4. For added stability, the base of the check dam can be keyed into the soil approximately 6 inches.
5. The maximum spacing between the dams should be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam (see Plate 3.20-2).
6. Stone should be placed according to the configuration in Plate 3.20-1. Hand or mechanical placement will be necessary to achieve complete coverage of the ditch or swale and to insure that the center of the dam is lower than the edges.
7. Filter cloth may be used under the stone to provide a stable foundation and to facilitate the removal of the stone. See Std. and Spec. 3.19, RIPRAP, for required physical properties of the filter cloth.

Sediment Removal

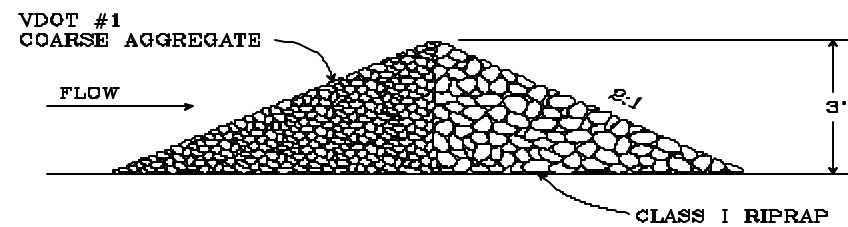
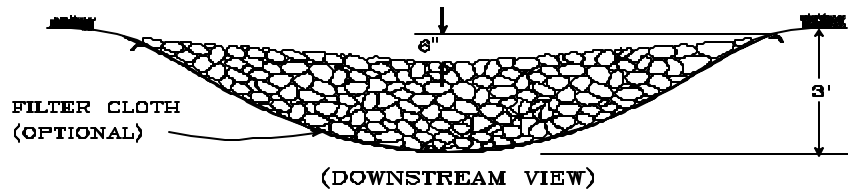
Sediment should be removed from behind the check dam when it has accumulated to one half of the original height of the dam.

ROCK CHECK DAM

2 ACRES OR LESS OF DRAINAGE AREA:



2-10 ACRES OF DRAINAGE AREA:

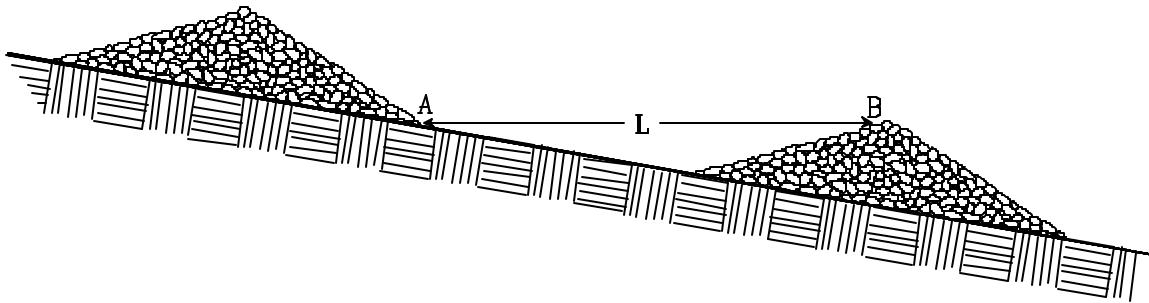


SOURCE: VA. DSWC

PLATE. 3.20-1

SPACING BETWEEN CHECK DAMS

L = THE DISTANCE SUCH THAT POINTS
A AND B ARE OF EQUAL ELEVATION



SOURCE: VA. DSWC

PLATE. 3.20-2

Removal of Practice

Unless they will be incorporated into a permanent stormwater management control, check dams must be removed when their useful life has been completed. In temporary ditches and swales, check dams should be removed and the ditch filled in when they are no longer needed. In permanent structures, check dams should be removed when a permanent lining can be installed. In the case of grass-lined ditches, check dams should be removed when the grass has matured sufficiently to protect the ditch or swale. The area beneath the check dams should be seeded and mulched immediately after they are removed. The use of filter cloth underneath the stone will make the removal of the stone easier.

Maintenance

Check dams should be checked for sediment accumulation after each runoff-producing storm event. Sediment should be removed when it reaches one half of the original height of the measure. Regular inspections should be made to insure that the center of the dam is lower than the edges. Erosion caused by high flows around the edges of the dam should be corrected immediately.